Analytical Solution for Gap-Excited, Leaky Slot Antenna Printed at the Interface Between two Semi-Infinite Dielectrics

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A method for the analytical calculation of the magnetic current for a gap-excited leaky slot antenna is presented. The solution procedure assumes a separability between transverse and longitudinal space dependence of the field, which is commonly used for thin slots. This procedure, which is conceptually the same as that adopted by *Mesa et. al.* (on IEEE Transactions on Microwave Theory and Techniques, pp.: 207 -215, Feb. 1999), is based on *i*) expanding via Fourier transform the impressed magnetic field in spectral superposition of longitudinal traveling waves with k_x wave-number; *ii*) solving by a MoM scheme the two dimensional CMFIE for each traveling wave; *iii*) integrating in k_x all the travelling wave responses. However, at difference with the work of *Mesa et al.*, in the present case we express in explicit analytical form the final representation of the spectrum, thanks to: *iv*) the assumption of a given (but respecting edge-singularity) transverse dependence of the electric field; *v*) a razor blade testing on the slot axis of the two dimensional integral equation. Despite the simplicity of the solution, the final results well agreed with those from a rigorous full-wave analysis over a wide frequency range. The analytical spectral expression allows simple determination of the complex value of the propagating leaky-mode wave-number giving a useful guideline for the design of leaky antennas. A k_x spectral Fourier integration is necessary to obtain the space domain expression of the magnetic currents on the slot line. This latter can be performed asymptotically by deforming the original contour into the steepest descent path and capturing the residue associated to the pole encountered in this deformation. The SDP integration can be interpreted as a source dependent field, while the residue contribution accounts for the intrinsic properties of the slot line. This representation also allows the definition of entire domain MoM basis functions which describe the current variation very close to or inside the gap excitations when the antenna to be investigated is of finite length and thus resonant rather than leaky.